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CONDITIONS WHICH DISCOURAGE SCIENTIFIC WORK IN AMERICA.

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THE picture of America's inferior place in the scientific world drawn by Mr. Carl Snyder in the January number of this REVIEW hardly does justice to the present state of research in our own country. It is quite near the truth as it was twenty or even ten years ago, but is not quite correct for to-day, when we see investigators of the first class in all the sciences coming forward in every direction. He states that we stand in the front in astronomy, and he might have added that our recent advance in all the physical sciences has been remarkable. I cannot speak confidently on the biological side, but would be disappointed if a competent judge should say that the pathological and other work now being done at the Harvard and Johns Hopkins medical schools was hopelessly behind in the race when pitted against that of the Pasteur Institute.

Notwithstanding all this, Mr. Snyder's picture is correct for the past, and, if not strictly so for the present, is still a wholesome lesson to one who desires to see our country pre-eminent in science and learning. It must be admitted that the great generalizations of science during our time are of European origin and that the initiative in their development has not been taken by us. The

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highest and best forms of research require the right atmosphere for their growth; and of this atmosphere intelligent public opinion is the most stimulating and, therefore, the most essential constituent. I desire to supplement the picture by another, showing how great the want we suffer in this respect.

Two supposed reasons for our backward condition are familiar. We are supposed to be not yet far enough beyond the backwoods stage of civilization to appreciate the higher form of intellectual progress or support works which are intended only to advance pure science. And it is not uncommon to hear men maintain—in whispers, perhaps—that indifference to the higher forms of thought is associated with democracy. I shall only remark on these suggestions that neither of them can be shown to be sound by a careful examination into the facts. We passed beyond the backwoods stage of learning half a century ago, and the development of our universities and educational institutions during the past twenty-five years shows that we are now entirely clear of it. Nor does there appear to be good evidence that a republican form of government is associated with indifference to science. No doubt, revolutionary France, up to the time of the Terror, showed a spirit antagonistic to all learning, as it did to every other creation of the past. But a wholly different view was taken as soon as sensible men got control of affairs. Republican France of to-day is no less appreciative of science than was the France of the First and Second Empires. So far as our country is concerned, the matter has been so well summed up by Mr. Bryce that I cannot do better than quote his conclusion: "To ascribe the deficiencies, such as they are, of art and culture in America, solely or even mainly to her form of government, is not less absurd than to ascribe, as many Americans of what I may call the trumpeting school do, her marvellous material progress to the same cause."

Of the high appreciation of scientific research and of learning generally entertained by our people we have the best proof in the munificence with which private individuals have endowed our institutions for learning and research. These men have desired to employ their wealth in a way which would promote the public weal and bring honor to their names. They were of sound judgment, fully able to feel the public pulse; and they saw that their fellow-citizens would look upon this as the most admirable way of disposing of their surplus wealth.

And yet our public, with all its appreciation of learning in the abstract, has only the vaguest and most imperfect idea of the true spirit of science and of the peculiar conditions under which the most advanced research is possible. We look upon the latter as if it were the practice of a profession, forgetting that, when it reaches that point, it ceases to be science. New methods, new laws, new results—these are the aims of science. We naturally forget that these are the creations of individual minds. When an institution for learning or research is munificently endowed by an individual, good sense and experience of the world naturally prompt him to establish something more lasting than the life of an individual—something of the nature of an organization which will continue to perform its functions, whatever changes may take place among the persons who direct or manage it. To him, scientific investigators are simply bodies of men of whose individual members he need know nothing.

Much the same is the impression which I have found by long experience to be that of the men who manage our public affairs. They look upon science as a profession, or collection of professions, which men learn at college or university much as they learn law or medicine. It is said—and, truly, I think—that no government is more liberal than our own in enterprises for the promotion of science. I do not know that our Agricultural Department has an equal in the world. The spirit of this policy may be expressed in some such form as this: "We see how much science has done for the world; how it has recast the whole industry of mankind and produced benefits to society of which our ancestors had no conception. Let us, then, promote scientific research and its application to practical ends on the largest scale. Men learn to be scientific investigators at college; our colleges and universities turn out thousands of graduates every year. Let us select the best of these we can find, pay them as good salaries as such men commonly expect to earn, and set them to work, each in his chosen field, under the best administrative direction we can get." Having done this, the function of the government is at an end. Of the individual men who are conducting the investigation the public need know no more than of the individual soldiers in an army.

There is no inherent error in all this; it is merely an incomplete view of the case, like the idea of an arch entertained by one who saw its entire figure, but knew nothing of the keystone. The leader in science, the divinely inspired explorer of nature—whom no university has made what he is, who has learned for himself how knowledge can be advanced, whose main outfit is the original genius with which nature has endowed him, whose paramount motive is a native impulse—has no place in the scheme. Yet, the whole history of modern progress, whether in science or industry, is a history of the efforts of exceptional men. How abnormal a man the native born scientific investigator is may be seen by the reflection that civilization was thousands of years old before men knew anything about the laws of motion which they saw in operation all around them every day of their lives, the power of steam or the source of electricity; that the wind had blown and the rivers had flowed all these thousands of years, without one member of the whole human race seeing how the water could be harnessed or the winds employed in the grinding of wheat. It is impressive to think how few men we should have to remove from the earth during the past three centuries to have stopped the advance of our civilization. In the seventeenth century there would only have been Galileo, Newton and a few other contemporaries; in the eighteenth, they could almost have been counted on the fingers; and they have not crowded the nineteenth. Even to-day, almost every great institution for scientific research owes its being to some one man, who, as its founder or regenerator, breathed into it the breath of life. If we think of the human personality as comprehending not merely mind and body, but all that the brain has set in motion, then may the Greenwich observatory of to-day be called Airy; that of Pulkowa, Struve; the German Reichsanstalt, Helmholtz; the Smithsonian Institution, Henry; the Harvard Museum of Comparative Zöology, Agassiz; the Harvard observatory, Pickering.

It is in our failure to estimate the individual scientific investigator that we stand so far behind other enlightened nations. I ask the reader's attention to some examples of this, beginning with men in the two hemispheres, who, in the matter of natural endowment, might be placed on an equality.

Henry and Faraday may be fairly taken as two such men. The former, born in obscurity and with no early education except such as an academy could offer, had a natural genius for interrogating nature which, under more favorable surroundings, might have given him the first place among the experimental philosophers of the age. What Faraday did we all know. But see the difference in the surroundings of the two men, and the incentives placed before them. The one was the honored of a great centre of the world's learning, commanding every facility that the wealth of scientific London could afford, stimulated by the appreciation of a great and influential society, and receiving so liberal a support that he had no need to think of the future. The other was a plain professor, commanding no apparatus but the meagre outfit of our traditional college, having none but students to whom he could personally communicate his discoveries; placed in a community which, though enlightened enough to regard what he was doing with interest, had no conception of the value attaching to his works. What wonder if he fell behind in the race!

Our own generation may supply another example. I speak subject to correction on a matter outside of my immediate knowledge in naming Max Müller and Whitney as the two most illustrious scholars in their branch of whom the English-speaking world could boast, and as being co-equal in learning and native power. But how different the positions of the two men! The one, notwithstanding his foreign birth, was honored of all England, and supported by almost princely liberality on a scale corresponding to his attainments, while the other was eking out the salary of a Yale professor by publishing text-books and editing a dictionary.

Let us suppose one side of another case. The greatest comparative anatomist in our country, combining the scientific eminence of a Jeffries Wyman and a Joseph Leidy, becomes an instructor of the public in the art of right thinking. He attacks cherished beliefs; he is contentious in the last degree, never letting go a subject as long as his opponents can have anything to say; criticises the course of his best friends whenever he thinks it wrong; is ready to make his voice heard on any question of which the public seems to him to be taking the wrong side, and that in a style of which the classic polish only adds to the pungency. What would we have done more than tolerate him? Would popular magazines twenty years ago have dared to publish his articles? Could he have reached, by virtue of his power of statement and scientific standing, a much higher level in the public estimation than other teachers of the same kind? Yet in England

Huxley was, perhaps, the greatest power that our generation has seen in moulding the current of national thought on the problems of life, and he was publicly rewarded by elevation to the rank of Privy Councillor to the Queen, a position which left few grades above him in the official hierarchy.

Within the past few years it has been the writer's fortune to assist at three celebrations in Great Britain, to each of which the learned of the world were invited. Two of the three were in honor of individuals. In 1896 the University of Glasgow celebrated the jubilee of Kelvin by a function which brought together an impressive representation of the science, not only of the whole British Empire, but of Europe and America. Three years later, the University of Cambridge celebrated the jubilee of Stokes in the same way. Immediately after the latter the Royal Institution of London celebrated its centenary. The point to which I call especial attention is that these celebrations were not merely meetings of learned men, but functions to which the leading classes of England, from royalty downward, gave dignity, either by their presence or by letter. The seventieth birthday of Helmholtz was celebrated by the great men of Germany, from the Emperor down, in a series of addresses and congratulations. The recent tribute of all France to Berthelot I need only allude to.

Is it significant of our inferior place in science that the idea of such celebrations in honor of science or a scientific man is so foreign to our notions that it is hardly likely to present itself for generations to come?

In thus pointing out the superior rewards and the superior position which the highest eminence in science and learning commands in other countries, it is not implied that these form the direct incentives to research. The idea that salary paid is the measure of service rendered leads to our pernicious habit of looking upon the investigator in the public service as a laborer for hire. The man whose aim in life is either gain or popular applause must seek other groves than those of Academus, for in them he will surely find none but chilly breezes. All modern experience shows that Nature does not make known her secrets to those who court her for lucre. The work of him who enters the field of science with any other immediate motive than the advance of knowledge will lack that thoroughness and comprehensiveness which is necessary to success. Disinterestedness is the first condition of the highest forms of research. In describing, as I have, the superior rewards offered in other lands to the highest success in research, I do not mean to imply that the man of science can have any such reward in view in mapping out his work. We may rest assured that if it should be suggested to an American investigator that he become the recipient of such an ovation as that bestowed on Kelvin or Stokes, he would be the more likely to nip it in the bud, if he could, the more worthy he might be of receiving it.

But let us not mistake what this means. It does not mean that the scientific investigator can work as well in poverty as in affluence, and must be indifferent to the question whether his children shall be well clothed or in rags, whether he himself shall be supplied with the comforts of life, or be unable to return the hospitalities of his friends. It does not mean that he is indifferent to his own standing in the world, and cares not whether men think ill or well of what he does. On the contrary, that he is doing something of which mankind will appreciate the benefit, and on which at least the best part of the world shall bestow its approbation, is the great incentive to his labors. He appreciates the difference between mere popular applause and enduring reputation; between seeing his name in a morning journal and believing that it will be associated by future generations with some great movement in the world of thought; between the good opinion of his fellowmen and the outward expressions by which that opinion is manifested. The thought of the English, German or French scientist who sees his country bestow its highest honors on some great investigator is not, "See what may be done for me if I am successful," but it is, "See what a high value my countrymen set upon the best kind of intellectual work."

Perhaps as telling an example as we can cite of the relative standing of pure science in this and in other countries will be afforded by a study of those national scientific organizations—academies, they are commonly called—which have been such important factors in the advance of civilization. Among the first of these to come into existence were the Royal Society of London and the Academy of Sciences of Paris. The former, originating in what, some two and a half centuries ago, was little more than a scientific club, gradually drew around it the leading men of science and letters in England, until it became a national scientific society whose reputation is one of the glories of Great Britain. The visitor to London who wants to know what the England of to-day thinks of its work has only to visit the Burlington House, erected by the government as a home of science and art, and see the quarters in which its collections are kept, its business transacted and its meetings held. If he wants to appreciate its actual value as a factor in British greatness, he has only to notice the close association between its leading members and the men who administrate the British government, and see how readily the latter can avail themselves of the knowledge possessed by the Royal Society on every subject which falls within its range.

In Paris, the visitor will find the five academies which form the Institute of France, perhaps the most eminent organization in the world of learning, housed in the Palace of the Institute, where the government has been providing for its wants for two centuries. The closeness of the relations between the Academy of Sciences and the government is shown in the constant calls by the latter for the services of the Academy. When a question arises in which expert advice can be useful, the Academy is asked for its opinion. If an important scientific appointment is to be made, the Academy is requested to present a list of the three best names from which one is to be selected.

In almost every other capital the same thing is true, in a greater or less degree. In Russia, the Academy of Sciences has nearly or quite the position of a branch of the government. Its ranks include one or more grand dukes, and the dignity of membership is high in the official scale.

In Germany, the body is more purely a learned one. Still, it is under the immediate patronage of the Emperor, and its wants are supplied in the same way as in other European countries.

We also have a National Academy of Sciences, chartered in the midst of the Civil War as an adviser of the government on all matters connected with science, literature or art. In a former number of this Review (May, 1900), the present writer described the origin of the Academy, and the public services which it has rendered. Of these, two merit consideration.

During the years preceding 1877 several independent and competing organizations were surveying and mapping the territories and duplicating each other's work at the public expense, even issuing independent maps of the same territory. Congress called on the Academy to devise a single comprehensive plan for these competing surveys. The result was the present Geological Survey, which has extended its operations over the whole country, and has given such satisfaction to the public and proved its value in so striking a way as to become one of the two greatest scientific bureaus at Washington.

The other case occurred only a few years ago. The Interior Department had time and again grappled in vain with the problem of administering the forests on our public domain, and preserving them for ourselves and our posterity from depredations by men and combinations of such influence that every effort to restrain them had failed. The National Academy of Sciences was called upon, because within its members was included that knowledge of the growth of forests and of the systems of administration in foreign countries which would enable a successful remedy to be devised. The outcome of the work was our present forestry system, the value of which, as administered by the Interior and Agricultural Departments, I shall not reflect on the intelligence of the reader by attempting to estimate.

Looking at what foreign governments have done for their academies, the question naturally arises: What has our government done for our own? The answer is: Absolutely nothing. Its condition as an academy of sciences is humiliating. It has no local habitation. It must pay its expenses, clerical and otherwise, of every kind, by the contributions of its members. In the eyes of foreign academies it is the official representative of our growing American science, and as such holds a high rank among such bodies. When it comes to doing anything in a representative capacity to uphold that rank, the expense must come out of the pockets of its members.

Nor is there a prospect of anything better in the future. Instead of increasing in influence, it seems almost to have passed out of recollection as a factor in our progress. Its last and greatest work for the government, that of devising a forestry system, marked its disappearance from the public view. It would be interesting to know how many men in Congress know what it is, or are even aware of its existence. Whether a census would show one in ten or one in fifty, no one can say. One hardly knows where to look for a spectacle less befitting our civilization than that of such a body of men searching through Washington to find a suitable place for their meeting; debating where they shall put the publications presented them by similar bodies abroad; grateful to one of their officers when he has a spare corner in which to keep their records; wondering what shall be done with an invitation from a foreign organization to send a delegate to a celebration or an international conference.

If the picture needs any additional touch, it is given by the fact that the Academy is required by its charter to give its services to the government gratuitously. Those of its members who spent their time in devising the two administrative systems which I have described could never receive a dollar for what they did; and to-day the Academy may be said to exist and live in the hope that, at some time in the near or distant future, the government may feel some need for its gratuitous services as an authority on the multifarious scientific problems with which public administration is confronted.

The founders of the Academy believed that the spectacle of a body of the ablest scientific investigators giving their services without reward to promote the public weal would act as an inspiring example, impress the public with a high sense of the dignity of science, and elevate learning in the eyes of our political leaders.

A cynic might reply that this only shows how slight was the knowledge of the world possessed by these men. Congress has no way of measuring the value of services lying outside the usual range of its experience except by their cost. When one works for nothing the value set upon his services will naturally be expressed by the mathematical zero. The idea that Congress would ever supply a place of meeting or a clerk to such men would never have been entertained by men of practical sagacity.

Between these views, I leave it to the reader to determine where the truth lies. I do not think any close observer of the operations of government during the past thirty years will contest the following proposition. If Congress, when it chartered the National Academy of Sciences, had supplied it with a fine building for its meetings, records and collections, had paid the expenses of every member who attended its meetings, had supplied it with the necessary assistance to enable it to conduct business continuously, and had provided that no appropriation should be made for any scientific object until it had been referred to and recommended by the Academy, the outlay would have proved, from a purely sordid point of view, a good paying investment.

This state of things looks all the more anomalous when we consider the unsurpassed interest which, as I have already shown, our people and its government take in the progress of science. If our views were no broader than those of the European peasantry and our national resources meagre in a corresponding degree, it would not be at all surprising that an Academy of Sciences should receive scant attention at the hands of government, and that men should be unable to see of what use it could be to the public. But how can such a state of things exist in a community and under a government like ours? The answer is clear. It is the natural outcome of that gap between the world of politics and the world of learning which is so marked a feature of society as it exists to-day, both in the country at large and at the National Capital. How the government and the learning of the great European nations are brought into contact I have already set forth, in describing the relations of national scientific organizations to their respective governments. But this does not constitute the sole point of contact between politics and learning abroad. To the American visitor to England, seizing the opportunity to make careful observations, no feature of public life will be more striking than the extent to which national leadership of every kind is united in a homogeneous mass. The leaders of thought and the leaders of action, the men of letters and the men of affairs, know each other personally, meet together, club together and dine together to an extent quite beyond anything that we know. At the annual banquet of the Royal Society one may see the government represented by one or more of its leading members. At the principal clubs he will find Members of Parliament, both lords and commoners, as well as men of science, art and letters. If he is present at an informal sociable at the house of a political leader, he may find the best known men of letters among them. Sitting in both Houses of Parliament will be found representatives of literature and science, the leading men of the universities, as well as the more prominent actors in all other walks of life. He will find men like Kelvin with a seat in the House of Lords, and hereditary lords interested in scientific investigation.

Very different is the case with us. I speak subject to correction; but my impression is that the foreign visitor to Washington, mingling with our public men, would not be likely to meet a single person whose name he would recall as prominent in the world of learning. If he attended the gatherings of the large body of scientific men now in the employ of the government, I speak with entire confidence in saying that he would not meet a single man prominent in public life, unless special arrangements were made for him to do so. During the last thirty years I know of only two well-known writers of books who have sat in either house of Congress. One was Mr. Cox, first of Ohio and then of New York; the other is the present junior Senator from Massachusetts. If the opinion that men of learning are, by that very fact, more or less incapacitated from being factors in public affairs is still entertained by any intelligent person, the examples of these men should set it at rest. Mr. Bryce has considered this subject somewhat briefly in the chapter in which he discusses the question why the best men among us do not enter into politics; but the special point here brought out seems to have escaped him.

This want of touch between our academic and political classes is at the same time the cause and the effect of the imperfections in the apprehension of things scientific by our public men. It is clearly abnormal. If a statesman cannot be expected to have a close acquaintance with the principles of science, he should at least be able to appreciate the special relation of each branch of research to the public welfare, and should know where or to whom to go for light on the relation of a scientific subject to the government.

It might naturally be supposed that this deplorable gap between the two classes whose co-operation is essential to the progress of civilization grows out of our backward condition as a learned nation, and will rapidly close up with the advance of intelligence. But the feature of the case which will, at first sight, seem most singular is that, instead of showing this tendency, the trend of events is in the opposite direction. That the gap is not a mark of our former backward condition in science and letters is shown by the fact that it did not exist in the early days of the republic. What little science the country had in his day was in close touch with Washington. Jefferson took pride in being personally acquainted with such of his countrymen as had any claims to a position in the world of learning. He was actively interested in scientific progress, not merely in a technical and machinelike way, but in promoting science through stimulating the work of individual investigators. Sometime in the forties a National Institute for the promotion of science was organized in Washington. It may surprise the reader of the present day to hear that, even at as late a date as that, men eminent in public life were leading members of this organization. Its first president was a Secretary of the Navy; its second a Senator. In the early days of our National Academy of Sciences it was much more a feature of Washington life than it is now. The fact of its annual meetings in Washington was known to men holding positions as high as that of head of a department, the daily journals reported and discussed its proceedings to a greater or less extent, and on one occasion a President of the United States appeared at a meeting.

We are not to regard this seeming case of decadence as proof of any retrograde movement in the intellectual standard of our politics. It is one of the natural features of social development—a result of that multiplication and differentiation of social functions which are characteristic of advancing civilization; and the only reason why it is not universal is that those agencies which prevent the same effect in other countries do not exist among us. Our statesmen find the problems of government which press on their attention continually increasing both in number and complexity, thus giving them less and less time for informing themselves on any subject lying outside the range of their immediate interests. The reason why the same effect is not produced in foreign countries will be seen from what I have already said. The association between science and politics has there been so closely kept up, both by custom and by the influence of men of learning in public affairs, as to counteract the tendency in question. Among us this binding influence has not existed and differentiation has gone on without impediment.

I see but one cure for these conditions, but one way of introducing the academic element into the political atmosphere of our capital. It is to make Washington a centre of learning in which all that is greatest in the human intellect shall be represented by leaders of world-wide reputation and strong personality, who can speak and act independently of government control, and thus be free from the restraint which shackles the utterances of a public officer. The most effective way to bring this about would seem to lie through the establishment of a great university or other scientific institution having as little connection with government as possible, yet not so foreign to it as to be of no interest to our authorities. Great things may be hoped of the Carnegie Institution as a coming agency of reform. One is bewildered in trying to forecast the results of an enterprise starting on so magnificent a scale and under conditions so promising as this does. What can be said is that there is every prospect of its proving such an agency in the promotion of knowledge as the world has rarely seen. Let us hope that the historian of the future shall also be able to add that it was the agency that brought the politics and the learning of our country into sympathy and harmonious co-operation.

SIMON NEWCOMB.